Queen Charlotte Islands Juvenile Herring Survey, August 2005

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QUEEN CHARLOTTE ISLANDS JUVENILE HERRING SURVEY, AUGUST 2005

by

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ABSTRACT

Thompson, M., and Therriault, T.W. 2007. Queen Charlotte Islands juvenile herring survey, August 2005. Can. Manuscr. Rep. Fish. Aquat. Sci. 2822: vi + 24 p.

In 2005 a Queen Charlotte Islands juvenile herring survey was conducted from August 9-19. Thirty-two sets were made at 8 locations within Statistical Management Area 2E. The study area extended from Cumshewa Inlet in the north to Louscoone Inlet in the south. The survey serves to address information gaps on the distribution, abundance, and size of juvenile herring in these nearshore northern waters.

Fourteen species of fish were identified in the purse seine catches with herring being the most frequently encountered species. A total of 2607 herring were measured resulting in a length frequency distribution that was distinctly bimodal representing age-0+ and age-1+ fish. Age-0+, age-1+ and age-2+ or older herring occurred in 75.0%, 59.4% and 37.5% of the sets respectively. No herring were caught in 12.5% of the sets. Seven oblique plankton tows and seven CTD casts were performed during the survey. Siphonophores and salp were the most dominant zooplankters by quantity.

RESUME

Thompson, M., and Therriault, T.W. 2007. Queen Charlotte Islands juvenile herring survey, August 2005. Can. Manuscr. Rep. Fish. Aquat. Sci. 2822: vi + 24 p.

Du 9 au 19 août 2005, un relevé des harengs juvéniles a été mené aux îles de la Reine-Charlotte. Trente-deux coups de senne coulissante ont été effectués dans huit endroits de la zone de gestion statistique 2E. La zone d'étude s'étendait de la baie Cumshewa à la baie Louscoone. Le relevé vise à combler les lacunes dans les données sur la répartition, l'abondance et la taille des harengs juvéniles dans ces eaux côtières du nord.

Quatorze espèces de poissons ont été identifiées parmi les captures à la senne coulissante; le hareng était l'espèce la plus fréquemment trouvée. Un total de 2 607 harengs ont été mesurés, et la répartition des fréquences de longueur était distinctivement bimodale, représentant les poissons d'âge 0+ et d'âge 1+. Les harengs d'âge 0+, d'âge 1+ et d'âge 2+ ou plus correspondaient respectivement à 75,0 %, 59,4 % et 37,5 % des poissons observés dans les coups de senne. Aucun hareng n'a été capturé dans 12,5 % des coups. Sept traits obliques de filet à plancton et sept mesures au moyen de sonde CTD ont été réalisés pendant le relevé. Les siphonophores et les salpes étaient les zooplanctontes les plus dominants en termes de quantité.

INTRODUCTION

Pacific herring (*Clupea pallasi*) are an important commercial species and a vital forage species for many marine mammals, birds and other fish in British Columbia's coastal waters. Herring spawn principally on marine vegetation in the upper subtidal and intertidal zones between February and June, with peak spawning occurring between March and April (Humphreys and Hourston 1978). Larvae hatch in two to three weeks, and disperse with surface currents, metamorphosing into juvenile herring at a length of ~25mm (Hourston and Haegele 1980). Herring are considered juvenile until they are three years of age and have joined the sexually mature spawning population (Hay and McCarter 1999). During daylight hours, juvenile herring congregate in schools, occasionally forming mixed aggregates with other pelagic species, close to shore near the bottom (Haegele 1997). At dusk, these fish migrate into surface waters to feed on plankton. During this time they are vulnerable to purse seine gear.

Relatively little is known about the distribution, abundance, and size of juvenile herring in the Queen Charlotte Islands (QCI) of British Columbia (Figure 1). This survey was designed to address information gaps and learn about the general biology of herring in this geographical area. The survey used an ecosystem based approach to biological sampling. Therefore, in addition to juvenile herring, all other fish species were retained for analyses. In addition, plankton samples and oceanographic data were collected. This approach will potentially provide a better understanding of the role and relationships juvenile herring have in QCI waters, and may provide an empirical forecast of recruitment to the herring fishery based on relative juvenile abundance.

METHODS

In 2005, the QCI juvenile herring survey was conducted from August 9-19. Thirty-two sets were made at eight locations within Statistical Management Area 2E (Table 1). The study area extended from Cumshewa Inlet in the north to Louscoone Inlet in the south (Figure 2). The set locations were randomly produced. Each day, 16 to 20 possible fishing locations were marked within a fishing location. A random number generator was then used to select four to five fishing locations for that evening. General sampling locations originally were chosen based on known historical herring spawning sites, and represent both nearshore and open water habitats as per previous juvenile herring surveys in the Strait of Georgia and the Central Coast (Haegele and Armstrong 2003, Henderson et. al. 2004, 2005 and Thompson and Therriault 2005).

Fish Sampling

The 12m, aluminium-hulled Fisheries Research Vessel *Walker Rock* was used for all fishing events. A 183m long and 27m deep seine net of knotless web, resulting in an area fished of ~2665m^2, was used for all fishing events. The body of the net had 46m of

22.2mm mesh at the tow end followed by 91m of 19.0mm mesh, and the bunt end was 46m of 9.5mm mesh. The net fished to a depth of 10m, and was able to retain fish greater than 20mm in length. All sets were made after dusk when herring are feeding near the surface. All sets were made "blind" at predetermined set locations. Up to five sets were completed per night, depending on location. Three days of fishing were lost due to vessel malfunctions. For most sets, it was possible to land the entire catch for biological sampling. On occasion, it was not practical to land a large set in its entirety, so sub-sampling was necessary. When sub-sampling was required, a 40kg tote was filled with randomly sampled fish and retained for biological sampling. Several dipnet samples from various parts of the net (catch) would be used to make up the random sub-sample. The remainder of the set was released over the corkline, its size estimated as the number of totes released. The number of herring caught in each set was determined by dividing the total catch weight by the mean weight of sub-sampled herring. The number of other species caught was determined in the same manner (Table 2). All fish retained for sampling were weighed, bagged and preserved in a 3.7% seawater formalin solution, with the exception of large predator species (e.g. adult salmon and dogfish). These fish were individually weighed and measured in the field.

From each set, 200 or more herring and all other fish species caught were identified, weighed and measured. If the set contained less than 200 herring, then all herring were weighed and measured. Consistent with standard practices, herring were measured to standard length; salmon to fork length; dogfish, hake, pollock and mackerel to total length.

Plankton Sampling

Seven stepped oblique plankton tows were performed during the survey (Figure 3). The tows always were completed after dusk and immediately before a fishing event. Dual 19cm diameter bongo nets with 350μm mesh were used for sampling, resulting in 'left' and 'right' bongo plankton samples (only left samples were retained for processing). The bongos were lowered to 20m and raised by an electric winch at a rate of 1m every 15sec. A General Oceanics® 2030R model flowmeter was attached to the left bongo to determine the volume of seawater filtered. Volume filtered was calculated using the following equation (McCarter and Hay 2002):

$$\mathbf{V = (A \cdot F \cdot K) / 999{,}999}$$

Where:

V = volume of water filtered through the plankton net (m^3)
A = area of net opening ($0.02835m^2$)
F = number of revolutions recorded by the flow meter (m)
K = standard speed rotor constant for 7cm rotor (26,873)

Upon retrieval, the bongo nets were washed with a high pressure deck hose, and the samples preserved in 3.7% seawater formalin.

In the laboratory, a volumetric splitter was used to reduce the sample size to a point where organisms could be conveniently counted and identified in a counting tray using a stereo microscope under 30X magnification. Sample splitting continued until a target size of roughly 300 organisms was reached (Thompson et al. 2003).

Plankters were identified to the lowest taxonomic level. Copepods were identified to species. Densities for all plankters were determined and expressed as plankters $\cdot$ m^{-3}.

CTD Sampling

To characterize oceanographic conditions in the surveyed area, a total of seven CTD (conductivity – temperature – density) casts were made using a Sea-bird model 16plus (Figure 3). A CTD cast was performed at each general fishing location. The CTD unit was weighted and lowered over the side of the vessel to a depth of 30m. A winch was used to return the CTD at a rate of 1m/sec. Data was downloaded to a laptop computer from the CTD unit after each cast.

RESULTS

Thirty-two sets were made during the 2005 survey resulting in fourteen species of fish and three invertebrate species being identified in the seine catches. The most frequently encountered species (>15% occurrence) included: Pacific herring, chum salmon, opal squid and pacific sardine (Tables 2 and 3).

Herring

A total of 2607 herring were measured resulting in a length frequency distribution that was distinctly bimodal. Based on this length frequency distribution (Figure 4), the length designations for the two juvenile herring age-classes were:

Age-0+ = herring less than or equal to 100mm standard length
Age-1+ = herring between 101mm and 146mm standard length
Age-2+ and older = herring greater than or equal to147mm standard length

Age-0+ herring occurred in 75% of the sets (Table 3). Table 4 shows the average length and weight for age-0+ herring, and the total herring catch weight at each set location. The mean length of all sampled age-0+ herring (n=1471) was 70.1mm.

Age-1+ herring occurred in 59.4% of the sets (Table 3). Table 4 shows the average length and weight for age-1+ herring, and the total herring catch weight at each set location. The mean length of all sampled age-1+ herring (n=999) was 118.9mm.

Age-2+ herring occurred in 37.5% of the sets (Table 3). The mean length of all sampled age-2+ herring (n=137) was 170.0mm.

Herring length-frequency distributions varied by location. The histograms display the length frequency for sampled herring only (Figure 5) but provide a representation of juvenile herring length distribution during the survey. The relationship between length and weight for all sampled herring was determined by fitting a logistic function to the length-weight data (Figure 6). Selwyn, Lower Juan Perez and Richardson Inlet resulted in the least amount of herring caught in relation to total catch while Cumshewa resulted in the highest proportion of herring caught (Table 2).

Plankton

There were 27 categories of organisms identified in 7 plankton samples (Tables 5 and 6). An average of 14.022m^3 of water was filtered per plankton tow. Copepods occurred in all samples. Chaetognaths, medusae, crab zoea, larvaceans, shrimp larvae and siphonophores were the only organisms to occur in all samples. Chaetognaths, cladocerans, copepods (*Corycaeus anglicus* and *Paracalanus parvus*), crab zoea, euphasiid larvae, gastropods, juvenile calanoid copepods, larvaceans, medusae, polychaetes, salp, shrimp larvae and siphonophores made up >75% of samples. Barnacle larvae, and crab megalopia occurred in 50 – 74% of samples. Amphipods, barnacle nauplii, copepods (*Acartia longimeres, Centropages abdominalis, Calanus pacificus, Epilabidocera longipedata, Oithona similes, Tortanus discaudatus*), ctenophores, eggs, and fish larvae occurred in <49% of samples (Table 7).

CTD

Seven CTD casts was performed for the survey. Data from one cast (Cumshewa Inlet) was lost due to an equipment failure. The CTD provided data for temperature (°C) and depth (m) (Figure 7).

CONCLUSION

Thirty-two stations were sampled resulting in 14 different fish species recorded from the purse seine sets. A total of 2607 herring were measured and weighed creating a distinct bimodal histogram representing two juvenile herring age groups. Seven plankton tows were performed resulting in siphonophores and salp being the most dominant zooplankters by quantity.

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Services and Dennis Chalmers provided crew support and good humour. Fisheries and Oceans provided the research vessel and laboratory facilities.

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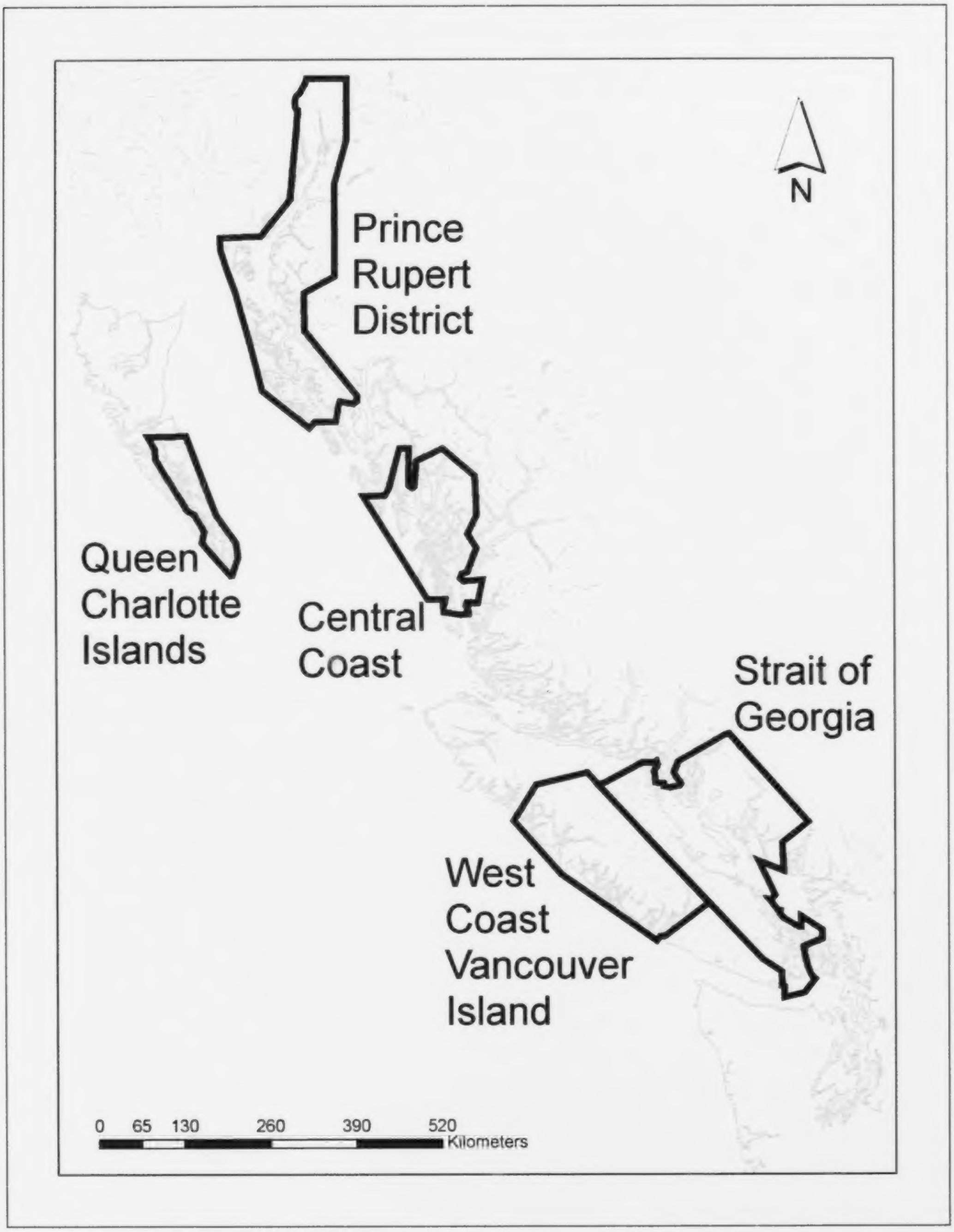


Figure 1. The five major British Columbia herring stock assessment regions: Prince Rupert District (PRD), Queen Charlotte Islands (QCI), Central Coast (CC), west coast Vancouver Island (WCVI) and the Strait of Georgia (SOG).

Figure 2. All set locations for the 2005 Queen Charlotte Islands survey.

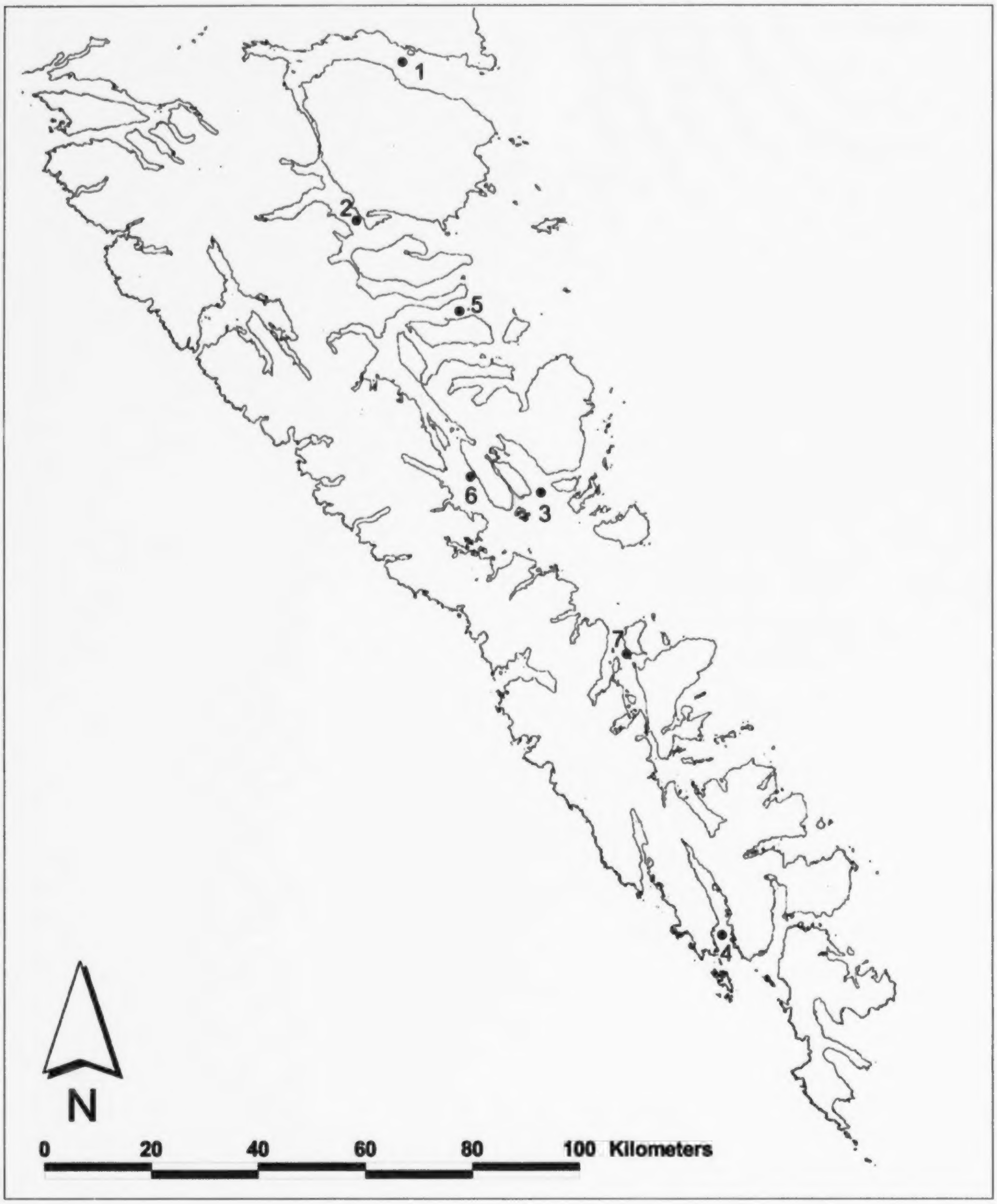


Figure 3. All CTD and plankton locations for the 2005 Queen Charlotte Islands survey.

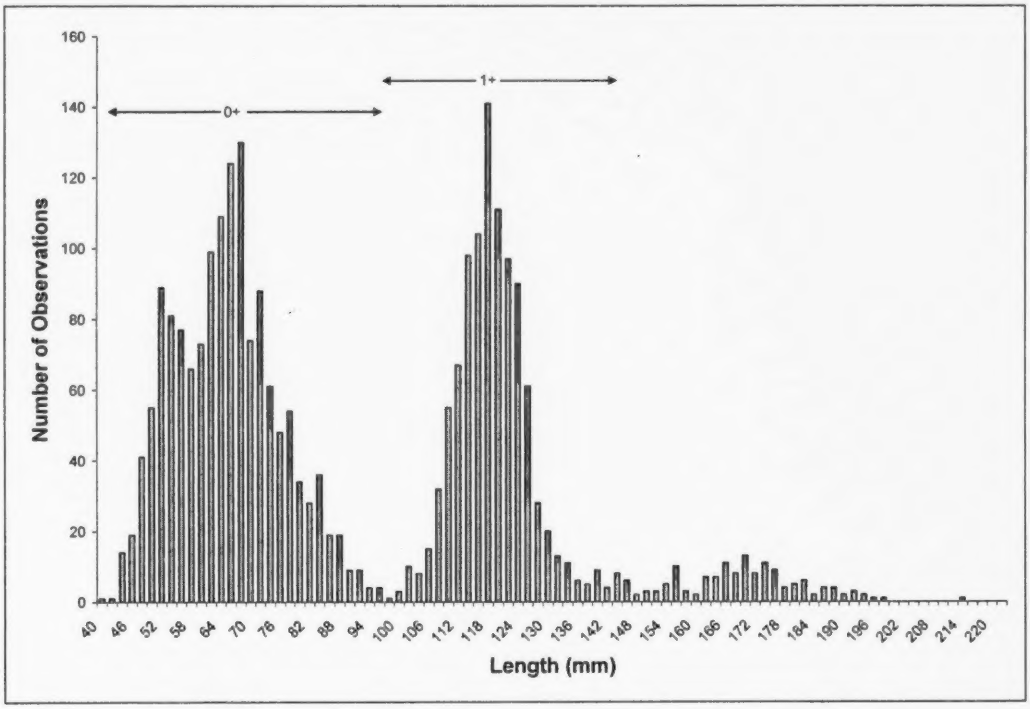
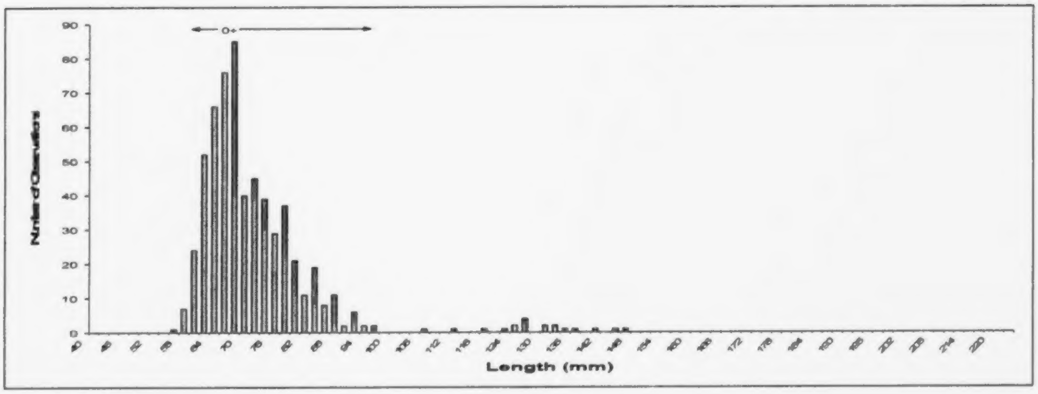
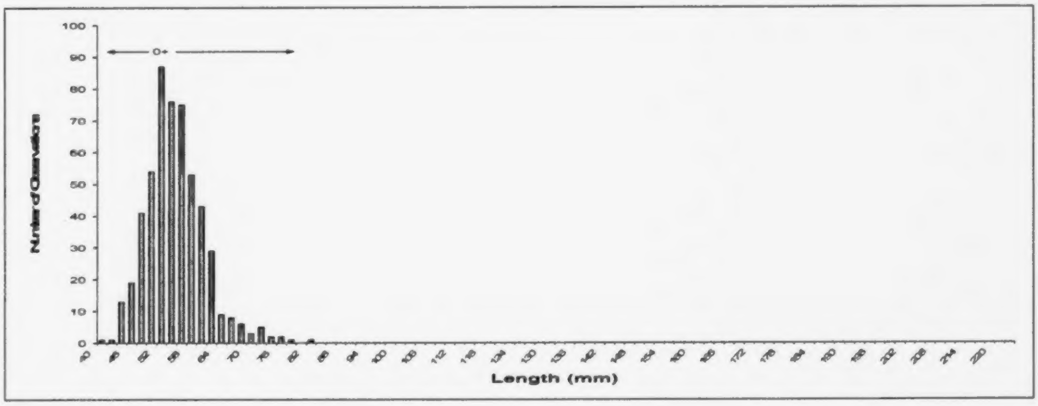


Figure 4. Length-frequency distribution for all sampled herring (N=2607).

Cumshewa Inlet



Louscoone Inlet



Logan Inlet

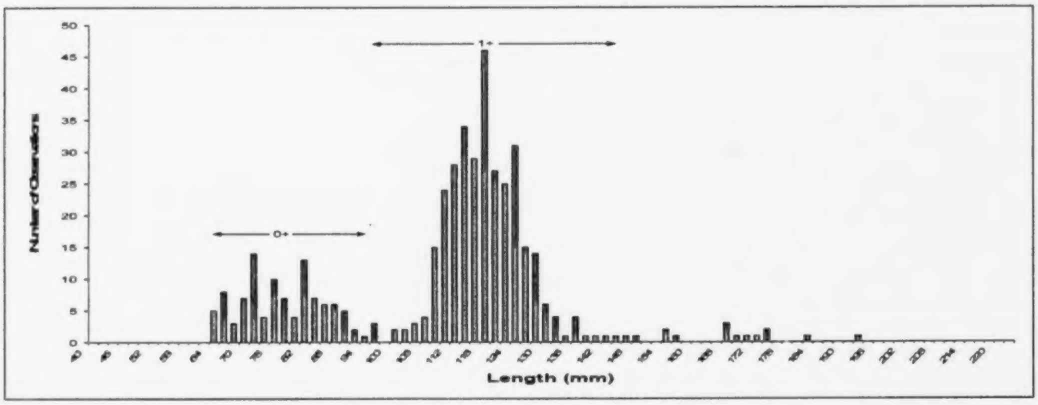


Figure 5. Length-frequency distributions of sampled herring by set location. Only sets with N>100 herring sampled are plotted.

Richardson Inlet

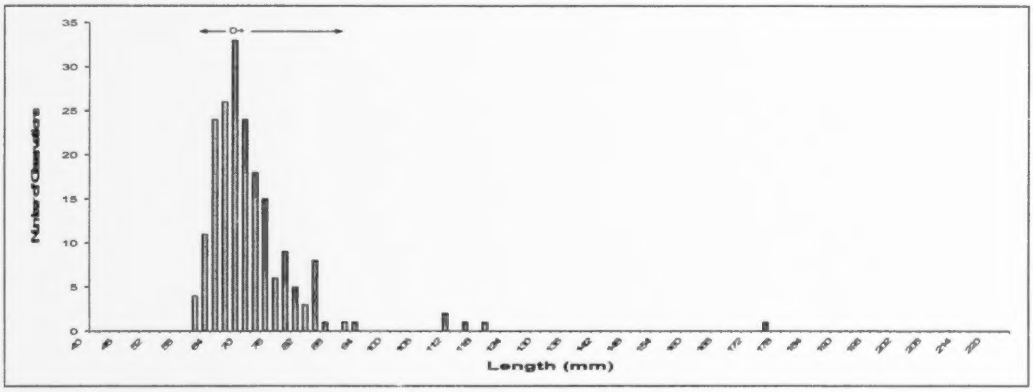


Figure 5 continued...

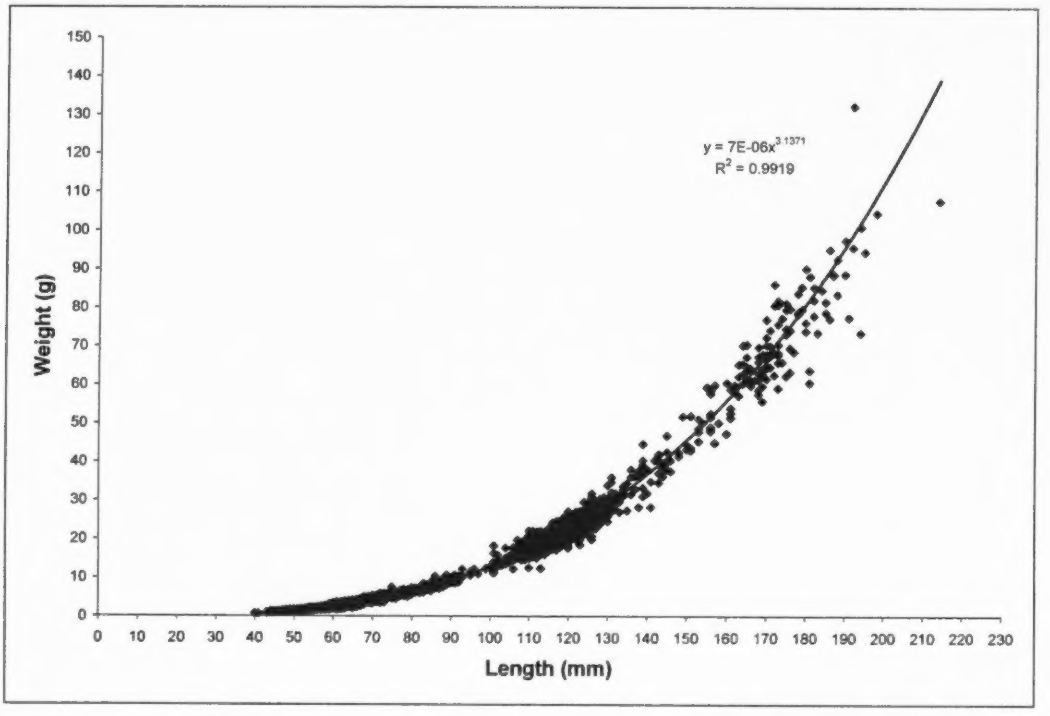


Figure 6. Length-weight relationship for all sampled herring (N=2607).

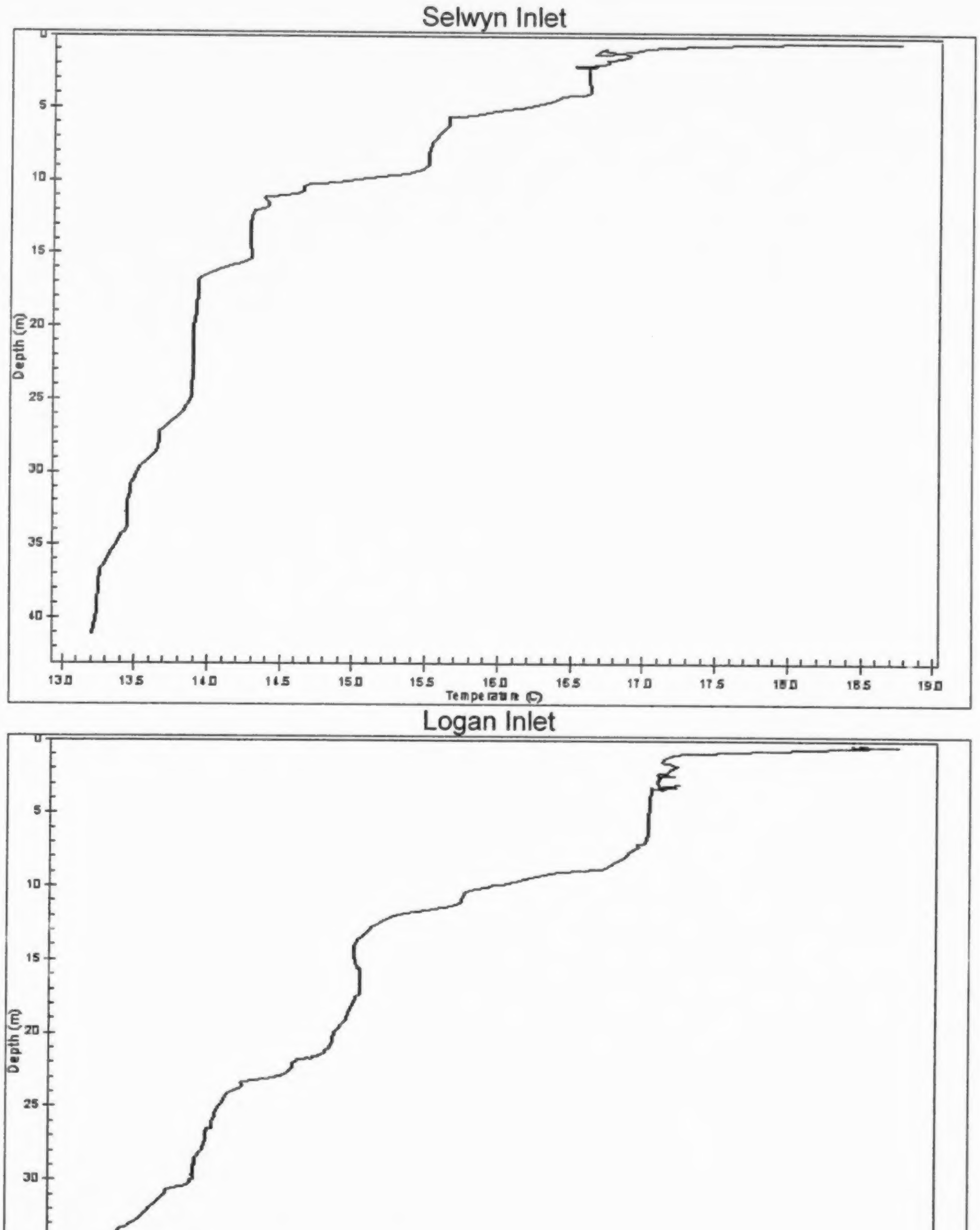
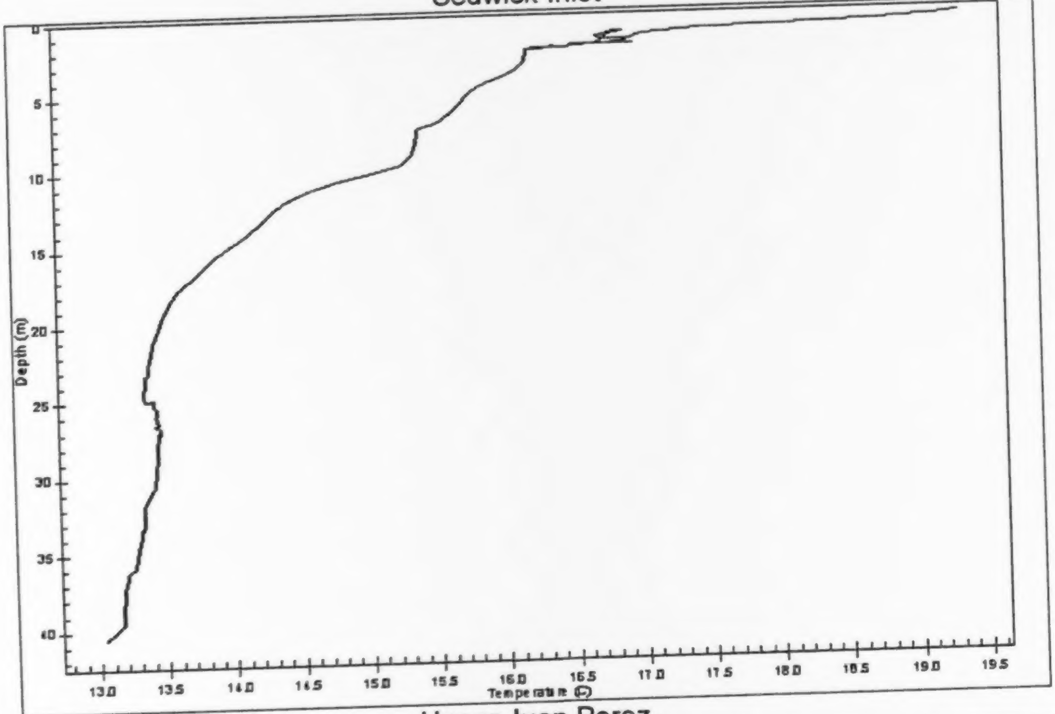
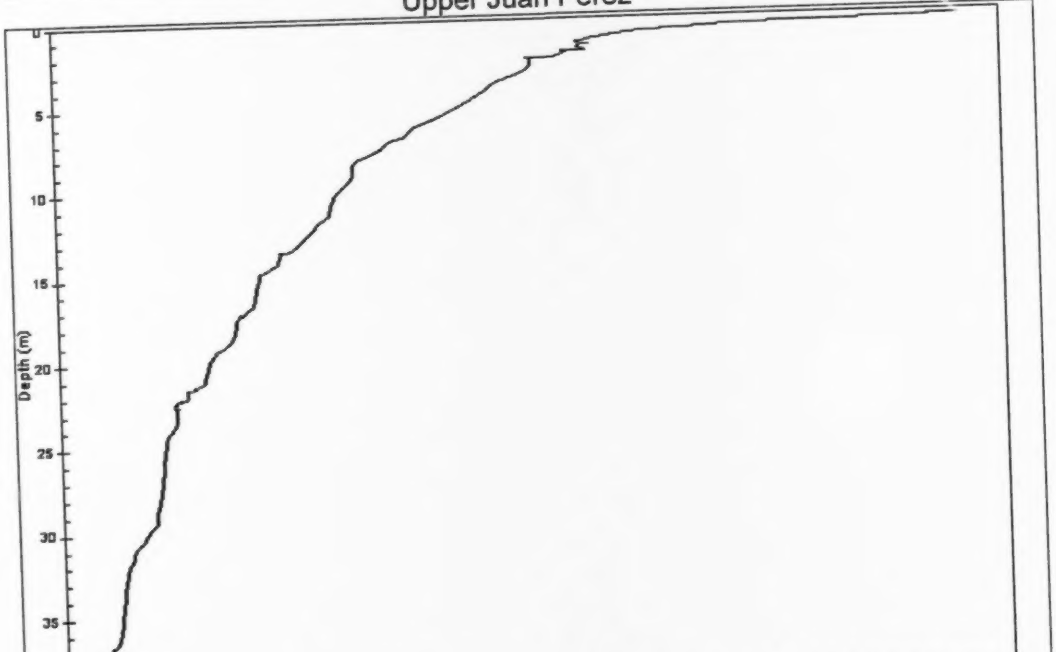


Figure 7. Temperature profiles from CTD casts.

Sedwick Inlet



Upper Juan Perez



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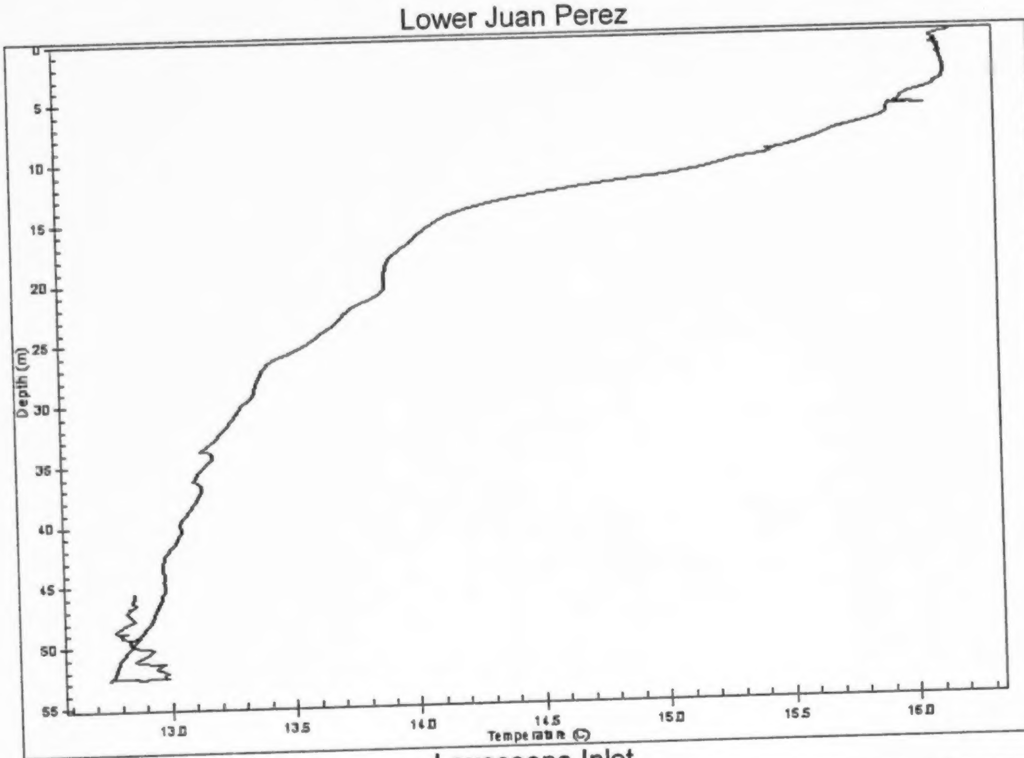

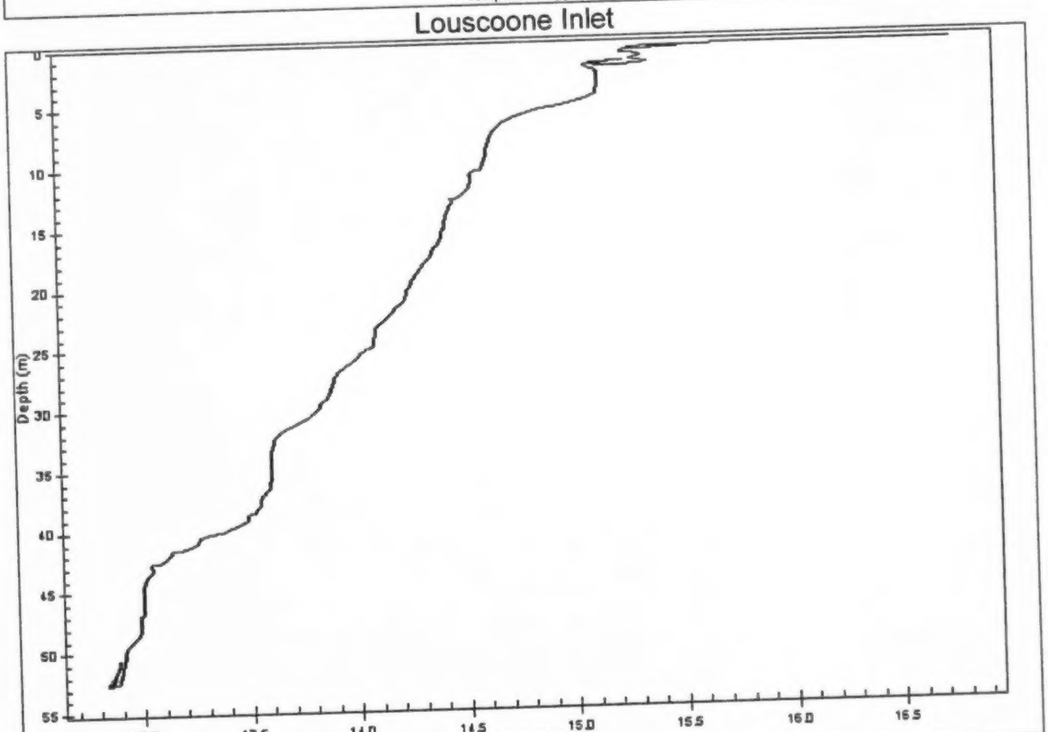

Figure 7 continued...

Table 1. Summary of the 32 sets made during the 2005 Queen Charlotte Islands juvenile herring survey.

Set	Month	Day	Set Code	Station	Section	Location Name	DD Lat (N)	DD Long (W)	Seine Set Time
1	8	9	1	1	023	Cumshewa Inlet	53.0413	131.7279	2230
2	8	9	1	2	023	Cumshewa Inlet	53.0335	131.7865	2340
3	8	9	1	3	023	Cumshewa Inlet	53.0604	131.8273	0040
4	8	9	1	4	023	Cumshewa Inlet	53.0450	131.9302	0200
5	8	10	2	1	024	Selwyn Inlet	52.8708	131.8395	2230
6	8	10	2	2	024	Selwyn Inlet	52.8985	131.8524	2330
7	8	10	2	3	024	Selwyn Inlet	52.8968	131.9313	0045
8	8	10	2	4	024	Selwyn Inlet	52.9336	131.9077	0150
9	8	11	3	1	021	Sedwick Inlet	52.5930	131.5265	2230
10	8	11	3	2	021	Sedwick Inlet	52.6120	131.5559	2315
11	8	11	3	3	021	Sedwick Inlet	52.6330	131.5659	0010
12	8	11	3	4	021	Sedwick Inlet	52.6464	131.5811	0105
13	8	12	4	1	006	Louscoone Inlet	52.1384	131.2133	2220
14	8	12	4	2	006	Louscoone Inlet	52.1589	131.2263	2300
15	8	12	4	3	006	Louscoone Inlet	52.1821	131.2306	2340
16	8	12	4	4	006	Louscoone Inlet	52.1881	131.2458	0015
17	8	12	4	5	006	Louscoone Inlet	52.2047	131.2654	0050
18	8	16	5	1	024	Logan Inlet	52.7849	131.6683	2225
19	8	16	5	2	024	Logan Inlet	52.7841	131.7358	2320
20	8	17	5	3	024	Logan Inlet	52.7705	131.6986	2205
21	8	17	5	4	024	Logan Inlet	52.7691	131.7776	2300
22	8	17	6	1	024	Richardson Inlet	52.7448	131.7015	0005
23	8	17	6	2	024	Richardson Inlet	52.7388	131.7056	0045
24	8	17	6	3	024	Richardson Inlet	52.7393	131.6517	0140
25	8	18	7	1	024	Upper Juan Perez	52.6173	131.6494	2200
26	8	18	7	2	024	Upper Juan Perez	52.5829	131.6584	2305
27	8	18	7	3	024	Upper Juan Perez	52.5732	131.5994	0005
28	8	18	7	4	021	Upper Juan Perez	52.5416	131.6094	0100
29	8	19	8	1	021	Lower Juan Perez	52.4640	131.4029	2205
30	8	19	8	2	021	Lower Juan Perez	52.4437	131.4128	2245
31	8	19	8	3	021	Lower Juan Perez	52.4140	131.4002	2330
32	8	19	8	4	021	Lower Juan Perez	52.4055	131.3727	0005

Table 2. Species number and weight by set.

Set	Location Name	Species*	Number	Weight (kg)
1	Cumshewa Inlet	**Pacific herring**	2	0.017
		Chum salmon	38	0.545
		Squid	12	0.258
		Jellyfish	-	0.837
2	Cumshewa Inlet	**Pacific herring**	3283	14.249
		Chum salmon	24	0.604
		Juvenile pollock	12	0.090
		Jellyfish	-	3.171
3	Cumshewa Inlet	**Pacific herring**	2743	14.074
		Chum salmon	24	0.331
4	Cumshewa Inlet	**Pacific herring**	4475	28.508
5	Selwyn Inlet	**Pacific herring**	2	0.018
		Pacific sardine	21	3.124
		Coho salmon	1	0.187
		Chum salmon	1	0.025
		Spiny dogfish	1	0.740
		Squid	126	3.864
		Jellyfish	-	5.694
6	Selwyn Inlet	Spiny dogfish	36	10.650
		Chum salmon	8	0.298
		Pacific sardine	15	2.534
		Squid	42	1.373
7	Selwyn Inlet	Chum salmon	15	0.491
		Spiny dogfish	3	2.200
		Squid	163	1.733
8	Selwyn Inlet	**Pacific herring**	2	0.021
		Chum salmon	12	0.262
9	Sedgwick Inlet	**Pacific herring**	61	1.748
		Chum salmon	6	0.220
		Pacific sardine	1	0.115
		Jellyfish	-	0.316
10	Sedgwick Inlet	**Pacific herring**	159	5.142
		Chum salmon	3	0.039
		Sockeye salmon	2	0.910
		Shiner perch	1	0.033

Table 2 continued...

Set	Location Name	Species	Quantity	Weight (kg)
11	Sedgwick Inlet	**Pacific herring**	204	4.900
		Chum salmon	12	0.278
		Coho salmon	2	0.416
		Juvenile pollock	2	0.076
		Squid	36	1.274
12	Sedgwick Inlet	**Pacific herring**	102	1.893
		Chum salmon	15	0.245
		Squid	60	1.251
		Jellyfish	-	5.013
13	Louscoone Inlet	Squid	12	0.179
		Jellyfish	-	1.844
14	Louscoone Inlet	**Pacific herring**	22	0.057
		Pacific sardine	8	0.915
		Squid	5	0.071
		Jellyfish	-	1.822
15	Louscoone Inlet	**Pacific herring**	43	0.086
		Juvenile rockfish	1	0.006
		Pacific sardine	70	8.234
		Squid	22	0.286
		Jellyfish	-	0.558
16	Louscoone Inlet	**Pacific herring**	204	0.363
		Pacific sardine	17	1.868
		Juvenile rockfish	2	0.004
		Squid	8	0.080
		Jellyfish	-	2.111
17	Louscoone Inlet	**Pacific herring**	260	0.480
		Prowfish	6	0.437
		Kelp greenling	1	0.102
		Jack mackerel	2	0.634
		Juvenile rockfish	3	0.067
		Squid	30	0.428
		Jellyfish	-	0.806
18	Logan Inlet	**Pacific herring**	17	0.315
		Chum salmon	5	0.139
		Squid	-	0.029
		Jellyfish	-	2.471

Table 2 continued...

Set	Location Name	Species	Quantity	Weight (kg)
19	Logan Inlet	**Pacific herring**	302	4.783
		Chum salmon	48	1.373
		Squid	-	0.856
20	Logan Inlet	**Pacific herring**	160	3.893
		Chum salmon	2	0.081
		Squid	74	2.484
21	Logan Inlet	**Pacific herring**	420	8.642
		Chum salmon	87	1.977
		Prowfish	3	0.750
		Squid	255	5.911
22	Richardson Inlet	**Pacific herring**	1	0.005
		Chum salmon	4	0.206
		Squid	37	1.032
		Jellyfish	-	2.442
23	Richardson Inlet	**Pacific herring**	2	0.072
		Squid	-	0.344
		Jellyfish	-	0.077
24	Richardson Inlet	**Pacific herring**	191	0.912
		Chum salmon	38	0.850
		Jellyfish	-	1.589
25	Upper Juan Perez	**Pacific herring**	58	1.700
		Squid	-	0.839
		Jellyfish	-	0.780
26	Upper Juan Perez	**Pacific herring**	56	1.878
		Squid	-	1.113
		Jellyfish	-	21.150
27	Upper Juan Perez	**Pacific herring**	43	1.800
		Chum salmon	9	0.241
		Jellyfish	-	4.625
28	Upper Juan Perez	**Pacific herring**	466	10.143
		Chum salmon	5	1.028
29	Lower Juan Perez	**Pacific herring**	100	3.535
		Chum salmon	61	2.165
		Pacific sardine	6	0.779
		Kelp crab	1	0.084
		Jellyfish	-	4.575

Table 2 continued...

Set	Location Name	Species	Quantity	Weight (kg)
30	Lower Juan Perez	Chum salmon	2	0.106
		Squid	-	0.308
		Jellyfish	-	0.575
31	Lower Juan Perez	**Pacific herring**	23	0.071
		Juvenile pollock	2	0.007
		Sandlance	1	0.002
		Squid	-	0.310
32	Lower Juan Perez	**Pacific herring**	4	0.018
		Chum salmon	1	0.016
		Juvenile pollock	1	0.006
		Three-spine stickleback	1	0.002
		Squid	-	0.128

* Invertebrates such as euphausiids (Phylum Arthropoda), comb jellies (Phylum Ctenophora) and jellyfish (Phylum Cnidaria) were frequently encountered but not included in this table due to quantifying difficulties. Any jellyfish included in the table refer to what was retained in the catch.

Table 3. Percent species occurrence in all sets.

Common Name	Scientific Name*	Set Numbers	Percent Occurrence (%)
0+ herring	*Clupea pallasi* in year of birth	1,2,3,4,5,8,10,12,14,15,16,17,18,19,20,21,22,24,26,27,28,29,31,32	75.00
1+ herring	*Clupea pallasi* in year after birth	2,4,5,8,9,10,11,12,18,19,20,21,23,24,25,26,27,28,29	59.38
2+ herring	*Clupea pallasi* in 2nd year of birth	9,10,11,18,19,20,21,23,25,26,27,29	37.50
No herring caught		6,7,13,30	12.50
Chum salmon	*Oncorhyncus keta*	1,2,3,5,6,7,8,9,10,11,12,18,19,20,21,22,24,27,28,29,30,32	68.75
Squid	*Loligo opalescens*	1,5,6,7,11,12,13,14,15,16,17,20,21,22	43.75
Pacific sardine	*Sardinops sagax*	5,6,9,14,15,16,29	21.88
Juvenile walleye pollock	*Theragra chalcogramma*	2,11,31,32	12.50
Juvenile rockfish	*Sebastes sp*	15,16,17	9.38
Spiny dogfish	*Squalus acanthias*	5,6,7	9.38
Coho salmon	*Oncorhyncus kisutch*	5,11	6.25
Prowfish	*Zaprora silenus*	17,21	6.25
Jack mackerel	*Trachurus symmetricus*	17	3.13
Kelp crab	*Pugettia gracilis*	29	3.13
Kelp greenling	*Hexagrammos decagrammus*	17	3.13
Sandlance	*Ammodytes hexapterus*	31	3.13
Shiner perch	*Cymatogaster aggregata*	10	3.13
Sockeye salmon	*Oncorhynchus nerka*	10	3.13
Three-spine stickleback	*Gasterosteus aculeatus*	32	3.13

* Invertebrates such as euphausiids (Phylum Arthropoda), comb jellies (Phylum Ctenophora) and jellyfish (Phylum Cnidaria) were not quantified.

Table 4. Mean lengths, weights and total catch weights of age-0+, age-1+ and age-2+ herring by set location.

Set Location	Mean 0+ Length (mm)	Mean 0+ Weight (g)	N	Mean 1+ Length (mm)	Mean 1+ Weight (g)	N	Mean 2+ Length (mm)	Mean 2+ Weight (g)	N	Total Herring Catch Weight (kg)
Cumshewa Inlet	70.0	4.51	583	127.7	29.18	19	-	-	-	56.85
Selwyn Inlet	71.0	4.19	2	112.5	15.13	2	-	-	-	0.04
Sedgwick Inlet	69.7	4.45	28	117.6	21.25	267	170.8	68.42	61	13.68
Louscoone Inlet	54.3	1.83	529	-	-	-	-	-	-	0.99
Logan Inlet	77.9	6.06	107	117.9	21.45	317	166.6	62.60	14	17.63
Richardson Inlet	69.6	4.53	189	112.3	18.42	4	173.0	59.10	1	0.99
Upper Juan Perez	85.2	8.53	5	118.4	22.30	314	172.8	70.72	38	15.52
Lower Juan Perez	62.9	3.48	28	125.8	26.74	76	166.6	64.98	23	3.62
All Locations	70.1	4.7	1471	118.9	22.07	999	170.0	65.16	137	109.32

Table 5. Categories of organisms identified in plankton samples. The four letter abbreviations are used to identify organisms in Table 6.

Coelenterata	
COEL	Medusae
SIPH	Siphonophores
Ctenophora	
CTEN	Ctenophores
Annelida	
POLY	Polychaetes
Mollusca	
GAST	Gastropods
Arthropoda	
AMPH	Amphipods
BARN	Barnacles
BARNn	Barnacle nauplii
CLAD	Cladocerans
CRAM	Crab megalopia
CRAZ	Crab zoea
EUPL	Euphausiid larvae
JCAL	Juvenile calanoids
SHRI	Shrimp larvae
Copepods identified to Species	
ALON	*Acartia longimeres*
CABD	*Centropages abdominalis*
CANG	*Corycaeus anglicus*
CPAC	*Calanus pacificus*
ELON	*Epilabidocera longipedata*
OSIM	*Oithona similis*
PPAR	*Paracalanus parvus*
TDIS	*Tortanus discaudatus*
Chaetognatha	
CHAE	Chaetognaths, mostly *Sagitta* sp.
Chordata	
FISHL	Fish larvae
LARV	Larvaceans
SALP	Salp
Miscellaneous	
EGGS	Unidentified eggs

Table 6. Zooplankton density by location by number of organisms per m^3 of water sampled. Species codes located in Table 5.

Set	Location	Water Volume (m^3)	ALON	AMPH	BARN	BARNn	CABD	CANG	CHAE	CLAD	COEL
1	Cumshewa Inlet	17.382	7.4	-	17.9	-	-	75.5	0.7	46.0	1.4
2	Selwyn Inlet	17.981	-	-	42.5	-	-	163.2	1.7	27.2	73.1
3	Sedgwick Inlet	7.321	5.9	5.9	-	5.9	-	129.6	11.8	88.4	42.7
4	Louscoone Inlet	10.862	431.8	-	25.0	-	3.5	-	0.8	7.1	0.1
5	Logan Inlet	9.410	-	-	35.0	-	-	17.5	16.4	26.2	89.6
6	Upper Juan Perez	17.116	-	-	-	3.6	-	74.7	21.4	14.2	60.5
7	Lower Juan Perez	18.083	-	-	-	-	-	7.5	0.9	-	7.5

Set	Location	Water Volume (m^3)	CPAC	CRAM	CRAZ	CTEN	EGGS	ELON	EUPL	FISHL	GAST
1	Cumshewa Inlet	17.382	-	0.2	41.2	0.5	1.8	-	5.8	-	14.7
2	Selwyn Inlet	17.981	-	-	181.9	-	81.6	1.7	-	-	204.0
3	Sedgwick Inlet	7.321	-	2.2	39.8	-	212.1	-	17.7	-	11.8
4	Louscoone Inlet	10.862	0.6	0.1	0.2	-	-	7.3	0.3	0.1	10.6
5	Logan Inlet	9.410	1.1	-	37.2	-	-	-	18.6	8.7	183.6
6	Upper Juan Perez	17.116	-	1.8	55.2	-	-	-	3.6	-	3.6
7	Lower Juan Perez	18.083	-	2.8	11.2	-	-	-	3.7	3.7	-

Set	Location	Water Volume (m^3)	JCAL	LARV	OSIM	POLY	PPAR	SALP	SHRI	SIPH	TDIS
1	Cumshewa Inlet	17.382	33.4	16.8	14.7	5.5	16.6	2.1	38.0	182.0	3.7
2	Selwyn Inlet	17.981	13.6	142.8	-	40.8	40.8	948.8	27.2	2176.5	-
3	Sedgwick Inlet	7.321	11.8	182.6	-	11.8	47.1	455.9	23.6	950.1	-
4	Louscoone Inlet	10.862	11.2	35.4	3.5	0.1	67.2	-	0.2	37.9	159.3
5	Logan Inlet	9.410	-	131.1	-	18.6	8.7	2183.2	9.8	853.4	-
6	Upper Juan Perez	17.116	3.6	7.1	-	-	3.6	1046.4	16.0	834.6	-
7	Lower Juan Perez	18.083	3.7	18.7	-	3.7	-	665.6	7.5	534.7	-